A Study of

STRIP MINE RECLAMATION UNDER OLD AND NEW LAW

by

Gilbert Bargar Black

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Advisor:

Dr. Wayne A. Pettyjohn

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ABSTRACT

Belmont and Noble counties have been strip mined since the early nineteen thirties with very few restrictions as to reclamation and mining operations. The Ohio legislature enacted a new Ohio strip mine law which went into effect April 10, 1972. Under this law mining operations and the reclamation of affected land are carefully controlled. Guidelines and procedures were developed to control run off and to restore the land to original use.

Soil samples from three mining areas, two under old law and one under new law, were collected and analized to see the effectiveness of new law regulations.

INTRODUCTION

Recently many articles and publications have been written about the affects of strip mining in the United States. A large majority of these articles seemed to employ scare tactics and it became difficult to separate the facts from yellow journalism. Many authors were for the abolishment of strip mining because of its impact on the environment while others sought stricter controls. Since a large percentage of the electrical power in Ohio is generated by coal, the abolishment of strip mining seemed impractical and even stricter controls would cause cost increases.

Randy Ankrom and the author became interested in these problems in September, 1973 and sought the help of Vernon Gerst of the Marietta Coal Company. Through the assistance of Mr. Gerst the author was able to collect soil samples from old and new law mines in Belmont and Noble counties.

The purpose of this investigation was to compare the effectiveness of reclamation under the new law as to that of the old law and to see if further controls are necessary.

MINING HISTORY AND METHODS

Strip mining is the process used in the extraction of coal from natural deposits by removing all of the overlying deposits. This process is the most effective of all mining procedures as it removes from ninety-five to one-hundred percent of the coal. It is most widely used in southeastern Ohio because of the relative ease in removing the overburden and exposing the coal.

Under old law mining procedures, the mining operation first moves into an area and bulldozes all of the foliage into ravines in surrounding areas. The overburden is then removed with no attempt made to save the topsoil or any of the subsoils. All overburden is merely shoved aside in the least expensive manner to expose the underlying coal. The coal is then removed and the overburden replaced. High walls are left standing and all of the foliage is left in the ravines or in piles on the surface. An attempt is made to smooth out the surface and this results in a plateau affect with towering highwalls. The area is then reseeded with trees and grasses. However, due to the manner in which the overburden is replaced, little vegetation survives and the area becomes quickly eroded exposing coal and sulphurous shales. These quickly oxidize and form acids, greatly changing the pH of the surrounding areas.

Under the new law an area is first surveyed to establish the exact contour of the land to be stripped and bonds are purchased from the state to insure that no damage is done to surrounding areas.

Trees are then removed and either sold or stockpiled to be buried in the new pit. The overburden is then removed with special care being taken to save the topsoils and subsoils for reclamation. After the coal is removed the mining operator has ninety days to replace the overburden in the same orientation in which it was removed. The area is then recontoured according to the survey at the start of the operation and a layer of topsoil, eight inches minimum, placed on top. The area is then reseeded with fast growing grasses to control erosion. The area is then inspected and if it meets the requirements of the new codes, one half of the bonds purchased by the coal company are refunded. One year later the area is inspected again and the rest of the bond returned. Not only do the inspectors pay careful attention to the reclamation of the strip mine, but strict attention is paid to drainage of acid waters from the area. Pollution of surrounding water sheds results in stiff fines and forfeiture of bonds.

DESCIPTION OF AREAS INVESTIGATED

Samples A-1 through A- 40 were taken from pits near Batesville and Quaker City, Ohio. These pits were reclaimed under the old law in 1972. The mines were planted with black locus close to roads and then seeded with grass. Very few trees grew and those that survived are doing poorly. The grass grew well when planted on the perimeter of the mine, but poorly in reclaimed areas. Vegetation in the area was extremely spotty and variations of growth occured withing a few feet of each other. These variations were evidence of the drastic changes in soil chemistry of the area reclaimed under

under the old law.

Under the old law the top soil was put back first and the overburden closest to the coal ended up on the top. This material contains large amounts of sulphur from the coal, and nitrogen from the organic material in the shale. The overburden in the area was composed of sandstone and shales.

Samples B-1 through B-50 were taken from the Banfield Road pit near St. Clairsville in Belmont County, Ohio. This area was mined and reclaimed under the old law by the Marietta Coal Company. Area B differed slightly because of the placement of top soil over the striped area. This area has a uniform cover of grass and a small amount of tree growth. The overburden is composed of sandstone and shale with an overlying cover of top soil.

Samples C-1 through C-107 were taken from the Barton Road pit near St. Clairsville in Belmont County. This area was reclaimed under the new law enacted in 1972. There is an absence of high walls and the vegetation is uniform, no erosion such as gullies being evident. The area is uniformly contoured and easily farmable.

INVESTIGATIVE PROCEDURES

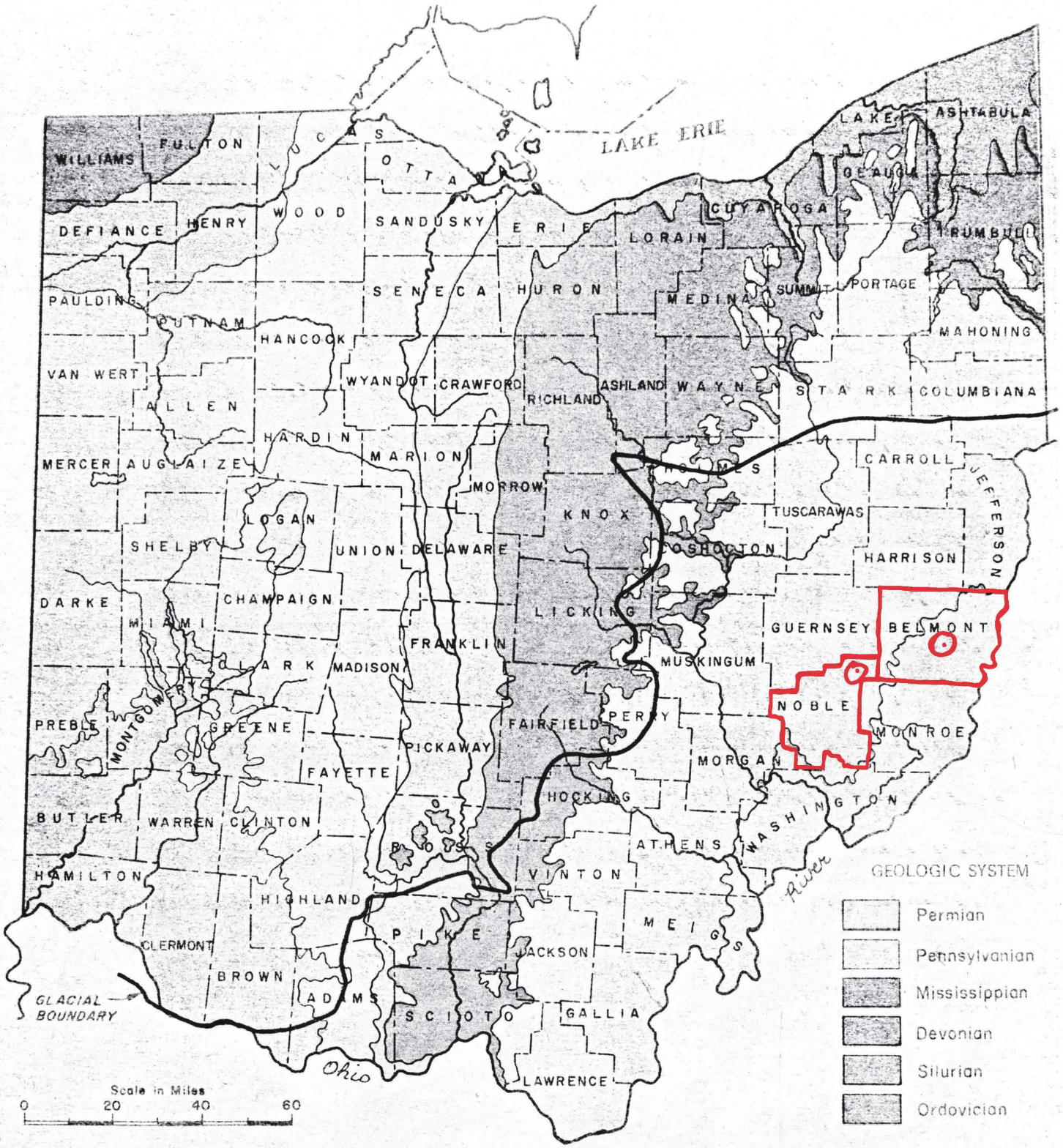
Soil samples were taken from three strip mines, all of approximately the same age but differing in the methods used in reclamation. The samples were taken from the top three inches of soil with a soil probe. Over fifteen probings were necessary for each individual sample to get a representative picture.

The method used to analyze the soil samples for pH was to place equal volumes of soil and water in a test tube, mix thoroughly, and allow to set for ten minutes. The sample was then read with a pH meter and recorded.

The same method was used to find the lime index except that buffer solutions were used instead of water.

To find the amount of available phosphorous, 10 ml of a solution of HCl and $(NH_4)_2MoO_4$ were added to a test tube. One half teaspoonful of soil was added and shaken vigorously for one minute. A small amount of stannous chloride was added to give a blue color complex and compared to the phosphate color chart.

The determination of exchangeable potassium was made by adding 10 ml of a solution containing $HC_2H_3O_2$ and $Na_3CO(NO_2)_6$. One teaspoon of soil was added and shaken vigorously for one minute. The solution was filtered and 5 ml of solution added to two-and-one half ml of anhydrous isopropyl alcohol. After three minutes the turbidity of the solution was compared with the standard shown on the Potassium Chart.



OHIO DIVISION OF GEOLOGICAL SURVEY

GEOLOGIC MAP AND CROSS SECTION OF OHIO

DATA
OLD LAW - STRIP MINE (A)
AGE 2 YEARS

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
A - 1	3.3	38	high	very low
A - 2	3.5			
A - 3	3.7			
A - 4	4.9			
A - 5	4.0			
A-- 6	4.2	42		
A - 7	4.5			
A - 8	3.5			
A - 9	3.2	31	high	very low
A - 10	3.2	30		
A - 11	3.5			
A - 12	3.5			
A - 13	3.6			
A - 14	6.4			
A - 15	7.1	73	medium	high
A - 16	4.6			
A - 17	3.5			
A - 18	3.7			
A - 19	5.7	56	high	high
A - 20	4.0			
A - 21	6.1			
A - 22	6.6	73		
A - 23	4.2			
A - 24	4.6			
A - 25	3.3			

con't DATA STRIP MINE (A)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
A - 26	3.6			
A - 27	4.2			
A - 28	4.1	43	very high	very low
A - 29	3.5	39		
A - 30	3.8			
A - 31	4.4			
A - 32	3.7	39		
A - 33	4.8	51	very low	low
A - 34	4.2	44		
A - 35	3.7			
A - 36	4.2			
A - 37	4.0			
A - 38	5.2	46	very low	very low
A - 39	3.8			
A - 40	3.6			
Average	3.99	46	high	low

DATA
OLD LAW - STRIP MINE (B)
AGE 2 YEARS

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
B - 1	6.1			
B - 2	6.6			
B - 3	6.3			
B - 4	6.2			
B - 5	5.9			
B - 6	4.3	40	very high	medium
B - 7	6.3			
B - 8	6.2			
B - 9	5.2			
B - 10	5.8			
B - 11	5.2			
B - 12	4.2			
B - 13	5.6			
B - 14	4.7			
B - 15	6.4			
B - 16	6.2			
B - 17	6.4			
B - 18	6.4			
B - 19	4.2	54		
B - 20	4.5			
B - 21	4.5			
B - 22	6.0			
B - 23	6.3			
B - 24	5.8			
B - 25	6.0			

con't DATA STRIP MINE (B)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
B - 26	4.0	51		
B - 27	3.3			
B - 28	5.6			
B - 29	5.8			
B - 30	5.5	44		
B - 31	3.8			
B - 32	5.9			
B - 33	6.3			
B - 34	6.4			
B - 35	6.2			
B - 36	4.9	66	very high	medium
B - 37	5.5	69		
B - 38	6.0			
B - 39	3.8	45		
B - 40	5.7			
B - 41	4.9			
B - 42	6.0			
B - 43	3.5	47	high	medium
B - 44	5.8			
B - 45	6.2	72		
B - 46	3.7			
B - 47	6.0			
B - 48	6.1			
B - 49	6.0			
B - 50	6.3	72	very high	medium

con't DATA STRIP MINE (B)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
B - 51				
Average	5.56	56	very high	medium

DATA
OLD LAW - STRIP MINE (C)
AGE 1 YEAR

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
C - 1	6.0			
C - 2	6.0			
C - 3	5.8	64	medium	high
C - 4	5.5	61		
C - 5	5.7			
C - 6	5.8			
C - 7	4.8			
C - 8	5.2			
C - 9	5.3			
C - 10	5.5	64	low	medium
C - 11	5.8	68		
C - 12	5.3			
C - 13	5.3			
C - 14	4.6			
C - 15	5.2			
C - 16	5.8			
C - 17	5.6			
C - 18	5.3			
C - 19	5.1			
C - 20	5.2			
C - 21	5.9			
C - 22	6.4			
C - 23	5.6			
C - 24	5.3			
C - 25	5.4			

con't DATA STRIP MINE (C)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
C - 26	5.7			
C - 27	5.8			
C - 28	6.0			
C - 29	5.5			
C - 30	5.8			
C - 31	5.7	64	low	medium
C - 32	6.0			
C - 33	5.5			
C - 34	5.6			
C - 35	5.7			
C - 36	5.6			
C - 37	5.6			
C - 38	5.9			
C - 39	5.2			
C - 40	5.3	58	low	low
C - 41	5.0			
C - 42	5.4			
C - 43	5.4			
C - 44	5.2			
C - 45	5.0			
C - 46	5.1			
C - 47	6.0			
C - 48	6.3	69	medium	medium
C - 49	5.7			
C - 50	5.8			

con't DATA STRIP MINE (C)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
C -51	5.3			
C - 52	5.3	60		
C - 53	5.3	53		
C - 54	5.5			
C - 55	5.3	61		
C - 56	5.8			
C - 57	5.9			
C - 58	6.2			
C - 59	5.8			
C - 60	5.7			
C - 61	6.0			
C - 62	6.1			
C - 63	5.0			
C - 64	5.8	65		
C - 65	5.5			
C - 66	5.6			
C - 67	6.0			
C - 68	5.7			
C - 69	6.4	69	low	very low
C - 70	5.5			
C - 71	5.6			
C - 72	5.7	64		
C - 73	5.1			
C - 74	5.0	53	medium	high
C - 75	5.5			

con't DATA STRIP MINE (C)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
C - 76	5.6			
C - 77	5.5			
C - 78	5.5			
C - 79	4.8			
C - 80	5.5	65		
C - 81	5.0			
C - 82	6.4			
C - 83	5.2			
C - 84	5.1			
C - 85	5.1			
C - 86	5.4	64		
C - 87	5.0			
C - 88	5.3			
C - 89	5.2			
C - 90	5.5			
C - 91	5.5	64		
C - 92	7.2	72	very high	medium
C - 93	5.7			
C - 94	5.9			
C - 95	5.1			
C - 96	6.3			
C - 97	5.0			
C - 98	6.8	70		
C - 99	5.4			
C - 100	5.4			

con't DATA STRIP MINE (C)

Soil Sample #	pH	Lime Index	Available Phosphorous	Exchangeable Potassium
C - 101	5.9			
C - 102	6.6			
C - 103	5.3			
C - 104	5.1			
C - 105	5.0			
C - 106	5.3	57		
C - 107	4.9	53	medium	medium
Average	5.5	63	medium	medium

INTERPRETATION OF RESULTS

In Area A the pH ranged from 3.2 to 5.2 except for areas covered with topsoil which averaged 6.5. This wide range of pH is probably due to haphazard replacement of overburden by the operator. Many areas had large "outcrops" of sulphurous coal and nitrogen bearing shale whose oxidation products contaminated surrounding soils. This results in a decrease in pH for the area. Since the availability or solubility of some plant nutrients decreases with an increase or decrease in pH, this area supports few plants.

The average lime index of Area A was 46 which indicated a requirement of more than thirteen tons of lime per acre to bring the pH up to 6. This is impractical as there are still materials near the surface which would oxidized in a matter of weeks lowering the pH again.

The availability of phosphorous was high which is good as it stimulates maturation and is necessary in the transformation of carbohydrates in plants.

Area A would be difficult to replant as the availability of potassium is low. Potassium is vital in the regulation of the rate of respiration, transpiration and the action of enzymes in plants. Potassium also has a counter balancing effect on the excesses of nitrogen which are present in the organic material of the shales exposed near the surface.

Area B had an average pH of 5.6 which is the result of the placement of topsoil by the Marietta Coal Company. Although not required by law when the area was mined, the use of topsoil resulted in a pH increase because the sulphur and nitrogen deposits were no

longer exposed and able to oxidize and produce acid soils. Available phosphorous was high while exchangeable potassium was very low. The potassium was probably leached away or never present in the topsoil of that area in the beginning.

In Area C which was reclaimed under the new law the average pH was 5.5 which is typical of soils surveyed in this area. The lime index was 63 which only requires 3.8 tons per acre to bring the pH up to 6 which is suitable for some crops. The available phosphorous and exchangeable potassium were both moderate which would also support crops.

These fiqures for Area C are an indication of an environment which is siutable for most grains, grasses and numerous hardwood trees.

CONCLUSION

It appears that the new regulations under the new law have alleviated most of the problems associated with the reclamation of stip mines. The problem now is what to do with the areas that have been stripped under the old law.

Since the composition of old strip mine soils is too acid for plant growth, it would be wise to use these areas for land fill such as subsoils and topsoils. Also regrading these areas would be useful in the control of acid ground water from these areas.

A careful study could be made of soils for each individual mine to see what type of plants or trees could survive in the environment and the area could be reseeded.

BIBLIOGRAPHY

Foth, H. D., and Turk, L. M., Fundamentals of Soil Science, John Wiley and Sons, Inc., New York, 1973.

Himes, F. L., Audio-Tutorial Notes For Soils, Burgess Publishing Company, Minneapolis, Minnesota, 1972.

Jackson, Duane, How to Take a Soil Sample, Ohio State University.

Ohio Strip Mine Law; Effective: April 10, 1972, Department of Natural Resources, Division of Forestry and Reclamation, W. H. Anderson Company.

1972-73 Agronomy Guide, Cooperative Extension Service, The Ohio State University, Bulletin 472.